Remarks

Status of Claims:

Without prejudice, Applicants have amended the claims to clarify the subject matter Applicants regard as their invention. Applicants have also added new claims 25-28. No new matter has been added.

Election/Restrictions:

The Examiner has indicated that the product claims 20-24 will be withdrawn and method claims 1-19 will be prosecuted. Applicants affirm this election without traverse.

Drawings:

The Examiner objected to the drawings because Figure 1 is informal and Figures 2 and 3 are not clear as to the various levels and depths of the substrate. The Examiner required corrected drawings in reply to the office action to avoid abandonment of the application. In reply, Applicants are submitting herewith proposed formal drawings which clearly illustrate the substrate with various levels etched into it.

Prior Art Rejections:

The Examiner rejected Claims 1-19 under 35 U.S.C. §103(a) as being unpatentable over Dautartas et al. (U.S. Patent No. 5,550,088, herein Dautartas) in view of Vieider et al. (U.S. Patent No. 6,516,448, herein Vieider). In supporting the rejection, the Examiner stated as follows:

> Dautartas teaches a method of preparing a substrate having alignment features for optical components. . . . A stop etch mast may be applied to a substrate. . . . . The substrate may be etched to define the fiducials . . . . Vieider is relied on to show that the substrate is etched to form U-groove for receiving the waveguide in order to have high degree of precision with respect to groove width and length for accommodate waveguide (abstract, col. 2, lines 17-47). Hence, it would have been obvious to one with ordinary skill in the art to use a U-groove of Vieider in the process of Dautartas in order to have high degree of precision with respect to groove width and length for accommodate waveguide.

Furthermore, with respect to the etching process in Claims 2 and 3, the Examiner states that:

> A person having ordinary skill in the art at the time of the invention would have found it obvious to try the combined prior art by adding any of the same well known features in conventional processes to same in order to provide their art recognized advantages and produce an expected result.

In reply, Applicants submit that the claimed invention as amended, and even as originally presented, is patentably distinct over the prior art.

Claimed Invention

The claimed invention provides for a substrate having highly precise alignment features for passively receiving and aligning components thereon. The accuracy and precision realized by the substrate of the present invention is due to a number of factors.

First, a single masking step is used which defines all the critical alignment features on the substrate. Traditionally, this was not possible because the various alignment features were formed with totally different processes requiring different conditions and separate masking steps. For example, a typical V-groove is deep and thus required a wet etching process, while fiducials for aligning devices have planar surfaces perpendicular to the substrate surface and thus required a dry etching process such as reactive ion etching (RIE). The applicants, however, have recognized that inductively coupled plasma (ICP) etching may

be used both for deep etching and for vertical planar surfaces. This one etching process allows for a single masking step which eliminates mask mismatches and tolerance buildup.

Second, the problem of crystallographic wafer orientation is obviated because the ICP process is an isotropic etching process meaning that it has essentially no dependency on the wafer crystal orientation. In fact, it should even work for polycrystalline wafers which are cast rather than grown epitaxially, and thus are much less expensive than crystalline silicon.

Therefore, the present invention exploits ICP etching to prepare more optimized, higher precision substrates having fiducials with vertical planar surfaces for passive alignment of devices, such as optical components.

Dautartas et al. (U.S. Patent No. 5,550,088)

Dautartas discloses a method for forming a self-aligned optical subassembly for supporting optical fiber and associated optical components. In particular, sequential masking and etches are performed so as to etch, in series, the largest opening first and narrowest opening last. By following this procedure, axial alignment between tandem grooves is purportedly maintained. Therefore, an important aspect of the is the fact that layers of masking are laid down sequentially depending upon the size of the opening to be etched. This necessarily means that more than one masking step is required. Indeed, "[f]igures 5-9 illustrate a set of exemplary steps used pattern a masking layer so as to form different thicknesses of masking material in the previously-determined etched locations." Col. 3, ll. 33-37.

Vieider et al. (U.S. Patent No. 6,516,448)[1]

Vieider discloses a device for passively aligning at least one substrate -carried optical fiber with at least one optical device. The substrate is patterned with a buried etch stop layer. The substrate is then etched to provide a pattern of U-grooves whose depths correspond to the thickness of material that overlies the etching stop layer and whose positions on the substrate are aligned relative to the optical device. The optical fibers are disposed and fixed in the groove.

Argument

1. Cited Prior Art Does Not Disclose Using a Single Masking Step to Define All Critical Component Positions on Substrate.

The primary reference upon which the examiner is relying, Dautartas, does not disclose using a single masking step to define all of the critical component positions on the substrate. To the contrary, the principle of the invention of Dautartas is to apply different masking layers sequentially to facilitate sequential etching steps. It is well established in patent law that there is no motivation to modify a reference if that modification would destroy the principle of operation of the reference. Here, an important aspect of the invention of Dautartas is to provide masking layers of various thickness over certain area depending upon the degree of etching required in the areas. To this end, Dautartas necessary requires the application of a series of masking layers (see Figs. 5-9 and associated text). Modifying this reference in accordance with the claimed invention would require destroying its principle of operation--i.e., sequentially applying masking layers to achieve different thicknesses. Thus, there can be no motivation to do so. Accordingly, the rejection should be withdrawn and the claimed allowed.

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[1]It should be understood that reference is not prior art. Indeed, Applicants made their invention well before the filing of this patent's application in the U.S. Nevertheless, Applicants, at this time, prefer to have the claimed invention distinguished over this reference based on its merits.

2. The Cited Prior Art Does Not Disclose Using Inductively Coupled Plasma Etching to Produce Fiducials with Vertical Planar Surfaces Adapted for Use as Register Surfaces for Positioning a Device on the Substrate.

There is no disclosure in Dautartas and Vieider of using inductively coupled plasma etching to prepare fiducials having vertical planar register surfaces for aligning devices on the substrate. Although Dautartas discloses fiducials, they appear to be wet etched (i.e., they are tapered) and hence do not have a vertical surface. Furthermore, there is no mention of using these fiducials as register surfaces for a device. Although Vieider discloses plasma etching to prepare vertical walls, there is no disclosure of using these vertical walls to align devices on the substrate. The reference merely states that the fiber may be "moved up against a well-defined stop, thereby enabling the fibre to be coupled more effectively to a laser, for instance" (col. 3, ll. 21-24). Such a statement falls far short of disclosing vertical fiducials for passively aligning devices on the substrate. Accordingly, the rejection should be withdrawn and the claims allowed.

In light of the above, an early and favorable response is earnestly requested.

Respectfully submitted,

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